

**MULTI-STAGE OPTICAL AMPLIFIER  
AND BROADBAND COMMUNICATION SYSTEM**

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A multi-stage optical amplifier includes at least a distributed Raman amplifier fiber and a discrete amplifier fiber. The amplifier is configured to be coupled to at least one signal source that produces a plurality of signal wavelengths  $\lambda_s$ ; and at least a first pump source that produces one or more pump beam

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wavelengths  $\lambda_p$ . A signal input port is coupled to the amplifier.

A signal output port is coupled to the amplifier. The distributed Raman and discrete amplifier fibers are positioned between the signal input port and the signal output port. A first pump input port is coupled to a first end of the distributed Raman amplifier fiber. A second pump input port is coupled to a second end of the distributed Raman amplifier fiber. The first end is located closer to the signal input port than the second end. A third pump input port is coupled to the discrete amplifier fiber.

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